

Trend detection and variability in low streamflows of mountainous catchments, Upper Indus Basin Pakistan

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Abstract

Climate change appears to accelerate the hydrological cycle and is expected to increase the frequency and impact of extreme events, such as droughts and floods. Being one of the very sensitive parameters, climate change can cause significant impacts on water resources by resulting changes in the hydrological cycle. The aim of this study is to investigate the variability analysis in low streamflows (1-day, 7-day and 15-day low flows) in 35 streamflow gauging stations of Upper Indus Basin (UIB) for the period 1961-2013. These stations are in 23 rivers in three river basins (Indus, Jhelum and Kabul). Trend analyses were performed by applying Mann-Kendall, a non-parametric test. Sen's method was applied to estimate slope time series that indicates changes in river flows. The influence of serial correlation was eliminated from time series by applying the trend-free pre-whitening (TFPW) method prior to the trend analysis.

Results of this study revealed that trends were more common in low flows (droughts). Statistically significant increasing and decreasing trends are noticed in different parts of UIB. Statistically significant decreasing trends were detected mainly in the eastern parts of UIB (in Jhelum Basin) whereas the northern and western part has the increasing trends. The overall study determined that 1-day, 7-day and 15-day flows are decreasing annually. In summer and autumn low flows were decreasing while in winter and spring were showing positive trend. The changes in low flows were -3%, 10% and -15% at the outlet of Jhelum, Indus and Kabul basins respectively. The prevailing trends and variability, caused by climate change, have an effect on the floods and droughts that should be considered by the water managers for better water management in a water scarcity country like Pakistan.